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THE FODDER PROBLEM IN THE BOMBAY PRESIDENCY

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THE FODDER PROBLEM IN THE BOMBAY PRESIDENCY.

CHAPTER I.

INTRODUCTORY.

"As in the previous year it was found that, so far as human relief is concerned, famine is almost a dead letter."

There is an obvious moral to this remarkable quotation from the General Administration Report of the Bombay Presidency for 1912-13. The problem of human relief has largely been solved by the economic development of the country; but economic factors have not as yet solved to any great extent the problem of the relief of cattle, although signs are not wanting that they are beginning to operate. Hence the question of supplying an adequate stock of fodder for agricultural cattle has received and is receiving the earnest attention of both the Supreme and the Local Governments of India, and the aim of this pamphlet is to indicate the measures adopted or contemplated by the Government of Bombay to provide a solution to that question.

Though the economic development of the country has solved the problem of human relief, that of cattle relief remains.

Investigation can obviously proceed on two main lines. On the one hand means can be sought for the better utilisation of the existing fodder supplies, and on the other experiment can be devoted to discovering new sources and forms of fodder. It will be convenient to treat these two divisions of the subject separately, although the one must to some extent overlap the other.

Two main lines of progress.

CHAPTER II.

UTILISATION OF EXISTING FODDER SUPPLIES.

Section I.—Fodder resulting from cultivation.

Two classes of fodder.

Existing fodder supplies may be classed under two major heads. The first consists of (*a*) natural grown grass and the second of (*b*) the results of cultivation.

Fodder resulting from cultivation.

The second class will be taken first, as its disposal will not occupy many lines. Its chief constituents are *Kadbi* and *Sarmad,* or the dry stalks of *jowári* and *bájri.* Similarly it includes the stalks and foliage of crops such as *vál* (kidney-bean) in the Konkan and ground-nut. At a further stage we reach by-products such as oil-seed cake, certain varieties of which constitute an excellent cattle food. It is not possible for Government action to affect the supplies of this class of fodder to any appreciable extent, because the cultivation of the crops that produce it must largely depend on economic factors. Cultivators will grow the crops that pay them best. But

Economies in its use.

Government has been able to show the rayat how to economise in their use of such fodders. They have striven to introduce and popularize chaff-cutters, the advantages of which were

The chaff-cutter.

explained in the Agricultural Department's leaflet No. 21 of 1909, and have been repeatedly emphasized at demonstrations all over the Presidency. If the stalks of the coarser kinds of *jowári* are fed to cattle whole, about half their weight is wasted. If they are first cut up with a hatchet, about one-third is wasted. But if a circular chaff-cutter is used and the residues are reduced to

a fine chaff, practically the whole will be eaten by the cattle. The cost of such a circular chaff-cutter is from Rs. 100 to Rs.200. The saving effected by the use of a chaff-cutter is therefore obvious. Very much cheaper chaff-cutters can be obtained, but they are less economical than circular cutters.

Ensilage and baling of kadbi, etc., to be treated later.

Ensilage and a scheme for baling and compressing *kadbi* will be described later under 'storage', and Government's efforts to popularize the use of oil-seed cakes and cognate cattle foods will be described in the chapter dealing with new sources and forms of fodder. The provision of adequate stores of fodder of this class is important, because stall-fed cattle which are used to *kadbi* do not thrive on jungle grass when compelled to use it as fodder in times of scarcity or famine.

Section 2.—Natural grown grass : collection.

Natural grown grass.

The way is now clear for a consideration of the economic utilisation of our existing supplies of natural grown grass. The subject is a large one, and it will be well to start at its beginning, *i. e.*,

Collection.

the collection of grass. Large areas of grass are available in forest and other areas which in years of prosperity are never cropped. But when fodder is scarce in the ordinary grazing areas, arrangements are made by the departments concerned to cut and bale these reserve supplies and to transport them wherever they may be needed. The activities of the Forest

The Forest Department's work.

Department are almost too well known to require mention, for as stated in a 'Note on Fodder Grass' prepared by the Government of India in January 1913, "the cutting and sale of grass from forests in Bombay is now a regular part

of the provincial famine programmes; operations have been carried out on a larger scale and more experience has been gained here than is the case in any other province." Steam and hydraulic presses are used to bale the grass, and to render it easier of transport, and a beginning has been made with motor transport, which will doubtless be used more and more extensively as the mileage of forest roads increases.

Section 3.—Natural grown grass: transport.

Transport.

The Forest Department thus makes available in times of scarcity supplies of fodder which are ordinarily not used. But as famine seldom attacks the whole of the Presidency, and still less the whole of India, at one and the same time, it is obvious that one area may have no available fodder while another has it in plenty. The problem is to transport the latter's surplus to the scarcity area. The special difficulty is that railway companies have found that the conveyance of even baled grass is the most unremunerative use to which their wagons can be put, and there has always been a difficulty in procuring the number of wagons required for an extensive grass traffic. The Government of India have minimised the difficulties of the private trader to a great extent by inducing the railway administrations to fix special low rates for fodder in times of scarcity. In October 1907 it was suggested that standard gauge railways should charge two annas per mile for ordinary wagons and four annas for bogies, and metre lines rather over half these rates. The railways generally agreed to quote these reduced rates, but the Government of India, realizing that even greater assistance was necessary in order to effect movement of fodder in quantities sufficiently large to provide for

The development and encouragement of famine fodder traffic by grant of concession rates.

the safety of cattle in famine areas, decided that freight on consignments of fodder booked to stations in the provinces then affected by famine should be recovered at the nominal rates of ½ anna per four-wheeled and 1 anna per bogie wagon per mile, and that the difference between these rates and those agreed upon by the railways should be paid by Government.

This arrangement is now a regular feature of Indian famine policy. It is the duty of each Local Government carefully to watch for an impending fodder scarcity, and as soon as it appears advisable to stimulate private traders to import grass, the Government of India are moved to order the application of concession rates. The frequent notices of the grant of concession rates to different areas that appear in the public press are sufficient guarantee that neither the Local Governments nor the Supreme Government are remiss in their duty.

Section 4.—Fodder Storage.

The storage of grass.

Now it will be natural for the reader to ask why, if such large supplies of grass are left untouched in ordinary years, arrangements should not be made in those years to collect and store it against times of scarcity and famine. The question is one that has recently been dealt with by the Government of Bombay. In September 1912 Mr. T F. Main, Deputy Director of Agriculture, read a paper before the Deccan Agricultural Association, entitled 'The Storage of Fodder.' He pointed out the absolute dependence of the average agriculturist on Government when the sudden, though not altogether unlikely, catastrophe of famine occurs. He instanced the case of Northern Gujarát, where the average careful man provides only one month's supply of fodder beyond that required to

Mr. T. F. Main's paper.

meet his needs in the fair season ending in June. He then explained the four main difficulties that confront a rayat in, say, the Kaira District, when he contemplates laying in a fodder reserve. First, there is the pernicious vice of incendiarism against which even the strongest is helpless. He cannot insure, for no insurance company will accept the risk. Secondly, the liability to theft is very great. Thirdly, the holdings are often very small, and in order to stock fodder the rayat would need to purchase it. Fourthly, though this does not apply so much to the Kaira District, the cultivation of commercial crops like cotton has had a tendency to reduce to a minimum the area sown with crops suitable for fodder. Mr. Main went on to show that if these difficulties could be overcome, the cultivator by storing fodder could protect his cattle against famine and often make a substantial profit by selling surplus stocks when prices rise in the hot weather.

The rayat's difficulties.

This paper suggested to Mr. Purshotamdás Thákurdás a comprehensive scheme for the creation of a reserve of fodder, which he presented to the Committee appointed to inquire into the question of constituting a permanent Charitable Famine Relief Fund. Mr. Purshotamdás was himself a member of this Committee. The outlines of his scheme were as follows :—

Mr. Purshotamdás Thákurdás' scheme for fodder storage.

> A portion of the Bombay Presidency Charitable Famine Fund should be invested in fodder storage. Government should advance twice as much as the public might subscribe to the fund. Any district wishing to have fodder stored therein will form a local committee with the Collector as chairman. This committee will then approach the permanent central committee with proposals

for storing at local centres certain quantities of hay which may be available in the district and to which the cattle may be accustomed, the local committee collecting one-fourth of the cost of such storage and the central committee providing the balance. The total stock required will be collected in the course of three or four years, and when complete an amount equal to the first year's collections will be placed on the market in the hot weather when rates are high, after being replaced by new fodder collected earlier in the season. In any year declared by proper authority to be a year of fodder famine in that district, the whole stock would be available for sale through the local committee at a rate to be fixed by the central and local committees in consultation, such selling rate being in no case lower than the cost of storage *plus* the proportionate charges of administration of the central committee. To attract capital, the central committee should be authorized to declare at their discretion a dividend of 4 per cent. per annum on the money subscribed, the dividends on free donations to the central fund being credited to the fund itself.

Mr. Purshotamdás believed that, if the committee were a joint stock company, it might easily pay a 6 per cent. dividend. To the possible objection that if the scheme were a business proposition, Government assistance would be unnecessary, he advanced the following answers :—

(i) Government itself is one of the greatest sufferers from famine and should therefore liberally assist any scheme to lessen and prevent its hardships.

(ii) The Government contribution will give the committee facilities and prestige which would otherwise be lacking.

(iii) There will be less danger from incendiarism if Government is known to have an interest in the stacks.

(iv) The local contribution will stimulate the people to see that the store laid in is the cheapest possible and that its distribution in times of famine is satisfactory.

The scheme investigated.

The Committee to which this scheme was presented submitted it to Government in January 1913 with a request that its potentialities might be thoroughly investigated. The Commissioners of Divisions were therefore requested to submit a joint report on the scheme after consulting the Conservators of Forests, the Director of Agriculture, and the Collectors of districts. They were also directed not only to consider the merits of Mr. Purshotamdás' scheme but to discuss in addition the general question of the practicability of fodder storage. The Commissioners submitted their report in August 1913. They reluctantly came to the conclusion that the scheme drawn up by Mr. Purshotamdás was impracticable and that its adoption would be inexpedient.

Difficulties of the scheme.

The chief practical difficulties were as follows :—

(i) To be of general value, the operations would have to be conducted on a vast scale, and an almost impossible amount of capital would be necessary. The expenditure incurred would be greater than that at present incurred by Government in times of scarcity on the importation of grass by state agency, and the risk would be great.

(ii) The estimates of cost, profit and loss given in the scheme are largely theoretical and it would be dangerous to rely on them.

(iii) It would be extremely difficult, and probably impossible, to find a market for the large stocks of grass that would have to be sold in April and May.

(iv) Finally, the members of both the central and local committees would for the most part be amateurs of little or no business experience, and the committees would almost certainly be lacking in cohesion.

The difficulties illustrated in Kaira.

It may here be added that the Bombay Presidency Charitable Relief Fund Committee actually made an experiment in fodder storage on the lines of Mr. Purshottamdás' scheme with ten lákhs of pounds of grass placed at their disposal by Government in the Kaira district. The grass was delivered in the hot weather of 1913, and at an early date difficulties began to arise. Most of the work in connection with housing, selling and replenishing stores fell on the shoulders of the Collector and his staff, and after a year's experience he was obliged to inform the Committee that the experiment, if continued, would involve a recurring deficit, and to intimate that he would not in future be responsible for the disposal of old grass and the purchase of new. The Committee accordingly decided to give up the idea of storing hay in the Kaira district, at any rate, till better arrangements could be effected. In short, the Kaira experiment was a failure.

Inexpediency of the scheme.

The inexpediency of the scheme was held to consist in the fact that it does not aim at inculcating prudence and the need of foresight in agriculturists and cattle owners or at inducing them to take communal action or contribute in kind to a common store on which they would themselves be entitled to draw in times of scarcity. The Commissioners further

refused to subscribe to the theory, apparently underlying the scheme, that the absence of a full supply of fodder in any given district on the occurrence of scarcity is the result of an ingrained improvidence which the rayat is incapable of overcoming. Grass is a marketable commodity, and its disposal is largely subject to the law of supply and demand. If it pays the rayat better to sell his grass than to keep it in store, he will naturally do so. In his anxiety to secure a legitimate profit he is, it is true, prone to overlook his true interests and forget the risk he is running of having to buy back fodder at high rates in times of famine. But that he is incapable of learning is refuted by recent experience in the districts of Ahmedabad and Poona.

The rayat encouraged to help himself.

In the former, to a great extent in response to the persuasion of the district officers after the 1911 famine, not only have communal stacks been put together, but also private stacks belonging to individual agriculturists and containing a sufficient supply for all their plough cattle for a year; in the latter may be found dotted about freely over the district earthed-in stacks of *kadbi* where none could have been found a year or two before. The stacking of fodder in thatched and mud-daubed stacks was previously not uncommon in the Southern Marátha Country and parts of the Deccan. The Agricultural Department for several years past has been conducting experiments into the best methods of thus storing fodder, and the results are available to any agriculturist who will apply to the officers of the Department. The Department hopes to be able to encourage such storage in places where it already exists and to initiate it in places where it is not to be found at present, and, as already stated, a beginning has been made in Ahmedabad.

The Agricultural Department's experiments in storage.

Storage of forest grass.

After their criticism of Mr. Purshotamdás' scheme the Commissioners made certain suggestions by the adoption of which they hoped that the position as regards fodder might be bettered. First they referred to an experiment then being conducted by the Forest Department at Navápur in West Khándesh.

The Navápur experiment.

The experiment consisted in giving a contractor a monopoly of certain forest and waste land grass over a large area, on the condition that he should maintain a reserve of 25 lákhs of pounds of grass in machine-pressed bales from April to October. After October the reserve is at the contractor's disposal on payment of royalty, but it has to be replaced annually by fresh grass. In famine years the reserve and an additional 225 lákhs of pounds are at Government's disposal at a fixed rate, but in ordinary years after the reserve has been replaced, all the grass is at the contractor's disposal on payment of royalty. The Commissioners were of opinion that similar arrangements might be practicable in other localities.

Government requested the Conservators of Forests to investigate this question and their reports disclose the following facts. In order to make the contract acceptable and to create a useful reserve, the area must be a large one. A reserve of ten lákhs is the minimum feasible, and there must be at the very least an equal amount of other grass to enable the contractor to make a legitimate profit. Secondly, the grass area must be concentrated, with good communications and accessible markets. Thirdly, the grass must be of good quality so as to sell readily in non-famine years. It has been found impossible to discover areas that satisfy all these conditions, and the extension of the

Navápur experiment to other areas has therefore of necessity been dropped. But another plan has been suggested which, if practicable, will have much the same effect as the Navápur arrangement. By this plan dual tenders would be invited for the grass in Government *kurans* and other areas. The contractor would have to specify (*a*) the amount he would pay for the unrestricted use of the grass in an ordinary year, and (*b*) the rate per 1,000 lb. of baled grass at which he would supply all the grass to Government in a famine year if required to do so before a certain date. It has been decided to try this plan in the Panch Máhals Forest Division in the current year.

Another experiment: the "dual tender" scheme to be tried.

The final conclusion at which the Commissioners arrived, and in which Government concurred, may be quoted *verbatim* :—

Alternatives to Mr Purshotamdás' scheme.

"It is guidance and encouragement that are needed rather than the making of costly experiments, and we are of opinion that the Agricultural Department can render invaluable assistance by encouraging cultivators to preserve and make use of all the available sources of fodder, some of which are now neglected, by obtaining grants of money towards the purchase of plant for the preparation of cattle feed in suitable localities, by employing itinerant demonstrators to be continually at work among the people and continually preaching the adoption of economical methods, and by undertaking elaborate experiments with a view to producing a cheap, easily transportable and always available fodder for use in all parts of the Presidency."

The measures adopted by Government to carry out the policy enunciated in the above quotation will be described

in Chapter III. Meanwhile, to render the section on storage complete, three other subjects demand treatment.

Fodder Co-operative Societies.

Though it has been shown that a centralized organization for the storage of fodder on a large scale is unlikely to be successful, there is a possible method by which something can, perhaps, be achieved on a smaller but still useful scale. At the Agricultural Conference held at Poona in September 1913, Mr. L. J. Mountford, I. C. S., Collector of the Poona district, submitted a paper entitled "A (Kadbi) Fodder Co-operative Society." In it he showed how fodder could be stored at a profit both to the society and its members. The difficulties experienced by the individual rayat, to which Mr. Main referred in the paper already mentioned, would be greatly minimised in the case of such a society. The society could afford to pay watchmen to guard against incendiarism and theft, and though ndividual members might have little surplus fodder, yet the contributions of all the members would easily provide a sufficient stock. The formation of such societies would possess an advantage that Mr. Purshotamdás' scheme lacked, in that it would encourage thrift in individuals and communal effort. But it must be recognized that the type of society described by Mr. Mountford is really communal rather than co-operative. In other words, there is no continuing society with an independent existence of its own apart from that of its members, undertaking certain responsibilities in its corporate character, receiving part of the profits, and owning a reserve fund. The action recommended is purely joint storage together with a sharing of the expenses, and leaves no room for the organization usually connoted by the word co-operative. A scheme for the establishment of true co-operative fodder storage societies has, however, been

drawn up, and is likely to be tried soon in Bijápur. The Collector of that district has already inaugurated ten communal storage societies with a capital of two lákhs of pounds of *kadbi,* and intends to place them on a co-operative basis. It may also be noted that one co-operative credit society at Gudur has started a *kadbi* store as a branch of its credit business.

Section 5.—Ensilage.

Ensilage.

There remains one method of storing fodder which possesses several unique advantages. *Kadbi* or grass while still green and containing the maximum of nutriment is deposited in " silos " or pits. A lid is carefully fitted on top and the fodder is kept in a state of compression by means of heavy weights. The lid pressing heavily on the grass drives most of the air out of the pit and the fodder remains fresh and sweet for long periods, so that good succulent fodder can be supplied to cattle right down to the end of the hot weather.

Advantages of ensilage.

Another advantage of this method of storage is that the fodder is practically immune from fire, theft, or damage by bad weather. The economy of making silage lies in the abundance of green grass, etc., which exists in August, much of which cannot be consumed then and there and ultimately becomes wasted owing to being trampled down by cattle or by growing over-coarse. Moreover the fodder can be cut early in the season before the price rises, and thus a profit can be made, especially in a year of scarcity. The Agricultural Department started experimenting with ensilage as early as 1883, but though the results with *pucka* built silos were most encouraging, the Department's example was not widely followed. But in recent years the Department

The economy of ensilage.

has gained so much in popularity and has obtained such facilities for educating the rayat by example and precept, that there are grounds for hope that silage will soon become popular at any rate with the larger and more intelligent cultivators. The exact method of making silage can be seen at most of the Government Agricultural stations. A survey of the results obtained at the Surat farm show that for every 100 lb. of green grass put into the silo, 70 or 80 lb. of good silage will eventually be obtained if care is exercised. The average cost of producing 1,000 lb. of silage is only Rs. 4-10-0, but in a year when green grass is scarce the cost would of course be somewhat higher. Cattle eat silage readily, and it is an excellent food for keeping them in good condition during the hot weather. The making of silage can therefore be confidently recommended as a safe and economical method of storing a specially nutritive fodder.

Experiments at Surat.

Section 6.—Kadbi bales.

Still another method of fodder storage has been suggested by the Director of Agriculture in his report on Mr. Purshotamdás' scheme. It is not new, and has already been successfully practised by the Army Department. It consists in storing, at some convenient centre or centres where *kadbi* is readily available in normal years, highly pressed bales of *kadbi* mixed with the leaf and husks of *tur*, gram and *math*. Such materials are very nutritious and when tightly baled are worth the cost of transport. The bales will keep indefinitely and are practically fire-proof. In the Crimæan war many such bales were sunk in the sea for six months and underwent practically no deterioration. The composition

Pressing and baling of *kadbi*.

Durable quality of the bales.

of the bales can be made up so as to provide a complete food for cattle in famine times, allowing for the roughage they can pick up. The transport of these bales by rail to any part of the Presidency affected by famine would be easy and relatively cheap. The Director has calculated that this type of fodder, after making allowance for storage, freight, insurance and all other charges, could be delivered at a place 100 miles from the storage depôt at a cost price of Rs. 13-8-0 per 1,000 lb. and that an animal could be kept for Rs. 3-8-0 per month on such fodder. In the Ahmedabad district during the 1911 famine the market price of grass ranged from Rs. 16 to 18 per 1,000 lb. and the grass was of such a quality that two or even three pounds of it would only be equal to one pound of the baled *kadbi*. The great economy resulting from the use of the latter will be at once apparent. The Director is now about to experiment further in the shredding and baling of *kadbi*.

Economical advantages.

CHAPTER III.

NEW SOURCES AND FORMS OF FODDER.

It is now time to turn to the second side of the fodder question, and to trace the measures adopted by the Department of Agriculture to discover and popularize new sources and forms of fodder. The use of silage and of compressed bales of *kadbi* has been already described, and it will be sufficient to note that it might be classed under the heading of this chapter as well as under that of storage. But there are two other forms of cattle food with which the Department of Agriculture has successfully experimented, and which merit close attention.

Cotton seed hulls.

The cotton tracts of the Presidency, especially Khándesh, suffer from a lack of fodder in proportion to the increase in the area of cotton grown. In the cotton tracts of America cotton seed hulls* are extensively used as fodder. Experiments with the feeding of such hulls were carried out in 1912-13 at the request of the Indian Cotton Oil Co., Ld., of Navsári, both on milch cattle and working bullocks. The experiments tend to show that the hulls are equal in value as a fodder to ordinary *kadbi*. It was found at the Surat farm that heavy Gujarát bullocks weighing 1,150 lb. can be maintained in good condition on light work when fed with 20 lb. of hulls as sole fodder plus 3 lb. of concentrates. The hulls cost Rs. 11-14-6 per 1,000 lb. delivered at Surat from Navsári. The great advantage of feeding cotton seed hulls instead of cotton seed whole, as is often done at present, lies in the fact that it is possible first to extract valuable by-products, *i. e.*, cotton seed oil and oil-cake. Hence the adoption of hull feeding would confer an immense economic benefit on the cotton tracts of the Presidency.

Prickly pear as an emergency fodder.

A second series of experiments were carried out in feeding cattle with prickly pear as a famine fodder. This had been attempted previously with some success, but further experiments were initiated in consequence of the appearance in the press of a letter from Mr. A. Norton, an American missionary of Dhond. Mr. Norton's work was studied on the spot, and a systematic experiment was started in January 1913 at the Civil Dairy, Kirkee.

A convincing experiment.

Six bullocks were purchased from the famine stricken district of Ahmednagar. With one exception they were in extremely poor condition.

*Hulls are the husk of cotton seed removed in oil mills.

The pear used was the common variety which is to be found anywhere along the roadsides and in jungles. The spines were removed by burning with oil stoves or blow lamps, the most economical of which proved to be one called the "Effective", price Rs. 22. Care has to be exercised to see that all the bigger spines are removed; some fine hair like spines are almost certain to remain, but will not have any ill effect. After the spines have been burnt off the slabs of pear are passed through a chaff-cutter. A knife such as is used for chopping *kadbi* can be substituted, but a chaff-cutter is of course quicker and more convenient. As the pear fed alone would not be sufficiently nutritious, an addition of 6 per cent. of cotton seed was made, and this mixture was fed to the cattle. At the beginning small quantities of the mixture were given with a quantity of chaffed *kadbi*, and the mixture was increased and the *kadbi* decreased daily, until after about a week the *kadbi* was entirely omitted. Of the six bullocks, four took to the pear readily and ate it greedily after about ten days. One other gave some little trouble, but ate it readily after a month. The last only began to eat it at the end of the experiment, but this was probably due to his extremely emaciated condition, for it was with great difficulty that he could be got to eat sufficient good fodder of any sort to regain condition. The cattle lost weight to some extent at the beginning of the experiment, but soon made up the loss and then actually gained weight. One bullock gained as much as 70 lb. The average amount of pear consumed was 32 lb. per head per day.

Cost of prickly pear rations.

The pear can be prepared at a cost of Rs. 1-4-0 per 1,000 lb. in a day of ten hours, and without allowing for wages a pair of bullocks can be fed with pear and cotton seed at a cost of Rs. 0-4-9 a day. One stove would be sufficient to burn

pear for 20 head of cattle. Prickly pear fodder was used for dairy stock at Mánjri farm when other fodder was dear, and effected a considerable saving. It was also used at the cattle camps in the Ahmednagar District in the 1913 famine with great success and the leading cultivators were much impressed with the demonstrations. Thus it is held to be conclusively proved that prickly pear, if fed with a 6 per cent. admixture of cotton seed, is a valuable emergency fodder in famine times and that it can be profitably fed to cattle in conjunction with other fodder when the price of ordinary fodder rises.

Special fodder crops.

The Agricultural Department has also made a study of special fodder crops and is trying to teach the rayat that it is often worth his while to cultivate part of his holding with a crop for his cattle's consumption rather than to grow commercial crops over its whole area. A type of *jowári* known as "Sundhia," and commonly grown in upper Gujarát has been found to be an excellent fodder crop and can be grown with or without irrigation as circumstances demand. Its advantages and the best means of cultivating it were fully described in the Department's leaflet No. 6 of 1909. Similarly leaflet No. 22 of 1909 pointed out the advantages of guinea grass, and seeds or roots for planting can be obtained from the Superintendent of the Agricultural College Farm at Poona. Lucerne or "vilayati ghás" is another splendid fodder crop to grow where irrigation is available. Its cultivation is described in leaflet No. 4 of 1910. Lucerne is perhaps rather too expensive a crop for the average cultivator to grow in ordinary years for his own consumption, but in years

Sundhia jowári.

Guinea grass.

Lucerne.

when famine or scarcity threatens, a paying course to adopt in Gujarát would be to sow Sundhia *jowári* in August, and, later, when the exact nature of the shortage can be estimated, to sow lucerne on ridges. The lucerne should be sown not later than the middle of November. The 1911 famine produced a considerable demand for lucerne seed in north Gujarát, and as it was renewed in 1912-13, the crop seems to have met with satisfaction.

Barsim or Egyptian clover.

Barsim or Egyptian clover is another crop that does very well under irrigation. There is a large demand for it in Sind, though its cultivation is at present mostly confined to Government farms. Few zemindárs on the Jamrao canal have taken up its regular cultivation, because it does not give a direct return in cash. Its value, however, both as a fodder and as a soil renovator, is becoming recognized in certain tracts, and it is to be hoped that the short-sighted refusal to grow it will eventually be overcome. The crop was tried last year at the Dohad farm (Panch Mahâls district) and did very well after rice. The Department's leaflet No. 5 of 1911 gives a useful list of fodder crops for rabi and hot weather sowing, with details of the seed rate, approximate date of maturity and approximate outturn. It need only be mentioned in passing that the cultivation of fodder crops under irrigation is particularly encouraged by Government.

Encouragement of fodder growing under irrigation.

In times of scarcity special grants are made for well boring and water conservation. In Sind a special light rate of assessment has been instituted for natural grass grown by means of canal water, and Government ordered the water contained in the Ekruk tank in the Sholápur district, where famine prevailed in 1913-14, to be given free of charge for the irrigation of 2,000 acres of fodder crops proposed to be raised by the Famine Relief Committee.

Fodder combinations.

Besides seeking out new fodders the Agricultural Department has been at pains to devise combinations of different kinds of fodder. The best combinations of fodder to form rations for cattle in times of scarcity have been described in leaflet No. 4 of 1911. These are the result of scientific investigation combined with practical experience. The various fodders are always chemically analysed and their digestibility tested by comparison with recognised standards.

Scientific selection of fodder grasses.

Scientific investigation proceeds on several other lines. A systematic botanical investigation of grasses was recommended at the meeting of the Board of Agriculture held at Pusa in January 1906, and has since been a regular feature of the work of the Agricultural Department. The analyses of feeding stuffs performed by the Agricultural Chemist have increased from 17 in 1906-07 to 208 in 1912-13, and the total number of analyses from 596 to 1,661. Similarly the Economic Botanist has for several years past been investigating wild grasses and even weeds on the botanical side, to discover which species thrive best in the hot weather and possess a drought resistant and perennial character, and to solve other cognate questions. Selected wild grasses are sown in the Ganeshkhind Botanical Gardens and the most successful varieties are tested elsewhere. The information as to grasses so far collected will be useful for further work on pastures, and similar information is being collected as regards weeds, some of which possess a value as fodder. At first sight these minute investigations may not seem to promise much assistance towards the solution of the fodder question. In point of fact they afford the only means

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Establishment of better types of grass.

of improving the grasses now ordinarily used for fodder. At the Surat farm, for example, much progress is being made in the establishment of pure varieties of grass in the farm pasture land. The rayat knows well the difference between good and bad grass, and the Department can work only by precept and example. Indeed the Department actually possesses at Tegur a grass farm of its own. It has there been shown that large areas can be cleared of stones and jungle at small expense by selling the scrub growth to charcoal makers, and thereafter mechanical grass-cutters can be used. On ground so cleared the cutter can mow from 800 to 900 lb. of grass at a cost of one rupee as compared with the 400 to 500 lb. that can be cut by hand at the same cost. Four acres can be mowed in a day, and owing to the time and labour saved, grass can be cut when it is nutritious and before it becomes fibrous. The grass at the Tegur farm is being stored in stacks and in pit and masonry silos, so that the best method of preserving it may be discovered.

The Tegur grass farm.

Grass cutting machines.

This monograph can most fittingly conclude with the expression of Government's hope that its publication will serve to focus attention on the important question of fodder supplies and in itself will afford proof of the earnestness with which the Agricultural Department is dealing with the problem.

Conclusion.

APPENDIX.

A list of some of the Publications consulted.

The Annual Reports of the Department of Agriculture.

The Annual Reports of the various Agricultural Stations and of the Surat Station in particular.

Proceedings of the Agricultural Conference held at Poona on the 29th and 30th September and 2nd October 1909.

Proceedings of the Agricultural Conference held at Poona on the 15th to 17th September 1913.

Agricultural Department's leaflet No. 7 of 1911 and Bulletin No. 58 of 1913 on Prickly Pear Experiments, and leaflets No. 6 of 1909 on Sundhia Jowár, No. 22 of 1909 on Guinea Grass, No. 4 of 1910 on Lucerne, No. 4 of 1911 on Rations for Cattle when Fodder is scarce, and No. 5 of 1911 on Emergency Fodders.

(All the above printed and published at the Government Central Press, Bombay.)

Proceedings of the Board of Agriculture in India held at Pusa on the 15th January 1906 and the following days.

(Printed and published by the Superintendent of Government Printing, Calcutta.)

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